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BSI Standards Publication

Energy performance of buildings — Overarching EPB assessment

Part 3: General principles for determination and reporting of primary energy factors (PEF) and CO_2 emission coefficients

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This British Standard is the UK implementation of ISO 52000-3:2023.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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Energy performance of buildings — Overarching EPB assessment —

Part 3: General principles for determination and reporting of primary energy factors (PEF) and CO_2 emission coefficients

Performance énergétique des bâtiments — Évaluation cadre PEB —

Partie 3: Principes généraux relatifs à la détermination et à la déclaration des facteurs d'énergie primaire (PEF) et des coefficients d'émission de CO_2

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 163, *Thermal performance and energy use in the built environment.*

A list of all parts in the ISO 52000 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

This document is part of the ISO 52000 series of standards aimed at international harmonization of the methodology for the assessment of the energy performance of buildings (EPB).

For the correct use of this document, a normative template is given in Annex A to report the choices made on the possible options determining the PEF and CO_2 coefficient.

The target group of this document are all of the users of the series of standards related to the assessment of the EPB and especially national standardization experts or building authorities who are in charge of defining PEF and CO_2 emission coefficients.

In view of the complexity of the issue, the need for contextual knowledge and practicality of use, necessary comments and explanations have been included directly in the document. For the same reasons, parts taken from other standards are appropriate for inclusion in this document.

Table 1 shows the position (marked by "X") of this document within the modular structure as set out in ISO 52000-1.

The modules represent EPB standards, although one EPB standard may cover more than one module and one module may be covered by more than one EPB standard, for instance a simplified and a detailed method respectively.

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Table 1 — Position of this document (M1–7) within the modular structure as set out in ISO 52000-1

		Overarching	Building (as such)		Technical building systems										
Submodule		**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidifi-cation**	**Dehumid-ification**	**Domestic hot water**	**Lighting**	**Building automation and control**	**PV, wind,..**
sub1			**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
1		General		General		General									
2		Common terms and defini-tions; symbols, units and subscripts		Building ener-gy needs		Needs									
3		Applications		(Free) Indoor conditions without sys-tems		Maximum load and power									
4		Ways to express energy performance		Ways to express energy performance		Ways to express energy performance									
5		Building categories and building boundaries		Heat transfer by transmis-sion		Emission and control									
6		Building occupancy and operating Conditions		Heat transfer by infiltration and ventilation		Distribution and control									

The shaded modules are not applicable.

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Table 1 *(continued)*

		Overarching	Building (as such)		Technical building systems										
Submodule		**Descriptions**		**Descriptions**		**Descriptions**	**Heating**	**Cooling**	**Ventilation**	**Humidifi-cation**	**Dehumid-ification**	**Domestic hot water**	**Lighting**	**Building automation and control**	**PV, wind,..**
sub1			**M1**		**M2**		**M3**	**M4**	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
7		Aggregation of energy servic-es and energy carriers	X	Internal heat gains		Storage and control									
8		Building zoning		Solar heat gains		Generation and control									
9		Calculated energy perfor-mance		Building dy-namics (ther-mal mass)		Load dispatch-ing and operat-ing conditions									
10		Measured energy perfor-mance		Measured energy perfor-mance		Measured energy perfor-mance									
11		Inspection		Inspection		Inspection									
12		Ways to express indoor comfort				BMS									
13		External environment conditions													
14		Economic calculation													

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Energy performance of buildings — Overarching EPB assessment —

Part 3: General principles for determination and reporting of primary energy factors (PEF) and CO_2 emission coefficients

1 Scope

This document provides a transparent framework for reporting on the choices related to the procedure to determine primary energy factors (PEFs) and CO_2 emission coefficients for energy delivered to and exported from the buildings as described in ISO 52000-1.

It does not include considerations on other topics, e.g. nuclear waste, atmospheric particulate matter, deforestation, food and bioenergy competition, depletion of raw material resources, depletion of the soil.

This document specifies the choices to be made to calculate the PEFs and CO_2 emission coefficients related to different energy carriers. PEFs and CO_2 emission coefficients for exported energy can be different from those chosen for delivered energy.

This document is primarily intended for supporting and complementing ISO 52000-1 as the latter requires values for the PEFs and CO_2 emission coefficients to complete the EPB calculation, however it can also be used for other applications.

2 Normative references

The following documents are referred to in the text in such a way that some or all their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7345, *Thermal performance of buildings and building components — Physical quantities and definitions*

ISO 52000-1:2017, *Energy performance of buildings — Overarching EPB assessment — Part 1: General framework and procedures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7345, ISO 52000-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
primary energy
energy that has not been subjected to any conversion or transformation process

Note 1 to entry: Primary energy can be related to non-renewable energy and renewable energy. If both are taken into account, it can be called “total primary energy”.

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[SOURCE: ISO 52000-1:2017, 3.4.29, modified — "includes" is replaced by "can be related to" in Note 1 to entry.]

3.2
energy carrier
substance or phenomenon that can be used to produce mechanical work, electricity or thermal energy or to operate chemical or physical processes

[SOURCE: ISO 52000-1:2017, 3.4.9, modified — "or heat" has been replaced by "electricity or thermal energy".]

3.3
primary energy factor
PEF
ratio of the *primary energy* (3.1) to the energy delivered to, or exported from, the *assessment boundary* (3.5)

Note 1 to entry: Primary energy factor can refer to the total primary energy or to the renewable, or non-renewable primary energy. To be more precise it should be specified (e.g. non-renewable primary energy factor).

3.3.1
non-renewable primary energy factor for delivered energy carrier
non-renewable *primary energy* (3.1) for a given *energy carrier* (3.2), including the delivered energy and the considered non-renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: ISO 52000-1:2017, 3.5.17 modified — The term is completed by "for delivered energy carrier" and in the definition "non-renewable" is added before "energy overhead".]

3.3.2
non-renewable primary energy factor for exported energy carrier
non-renewable *primary energy* (3.1) for a given *energy carrier* (3.2), including the exported energy and the considered non-renewable energy overheads of producing and exporting to the collection points, divided by the exported energy

3.3.3
renewable primary energy factor for delivered energy carrier
renewable *primary energy* (3.1) for a given *energy carrier* (3.2), including the delivered energy and the considered renewable energy overheads of delivery to the points of use, divided by the delivered energy

[SOURCE: ISO 52000-1:2017, 3.5.21, modified — the term is completed by "for delivered energy carrier" and in the definition for "an energy carrier" the words "distant or nearby" have been deleted.]

3.3.4
renewable primary energy factor for exported energy carrier
renewable *primary energy* (3.1) for a given *energy carrier* (3.2) including the exported energy and the considered renewable energy overheads of producing and exporting to the collection points, divided by the exported energy

3.3.5
total primary energy factor
sum of renewable and non-renewable PEFs for a given *energy carrier* (3.2)

[SOURCE: ISO 52000-1:2017, 3.5.25]

3.3.6
renewable energy from renewable sources
energy whose source is naturally renewed and does not run out

EXAMPLE wind, solar, aerothermal, geothermal, ocean energy, hydropower, biomass, landfill gas, sewage treatment plant gas and biogases.

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3.3.7
non-renewable energy
energy from non-renewable sources
energy from a source which is depleted by extraction

EXAMPLE Oil, natural gas, coal, uranium.

3.4
CO_2 emission coefficient
coefficient that describes the amount of CO_2 that is released from doing a certain activity

EXAMPLE Burning one tonne of fuel in a furnace is an example of application.

Note 1 to entry: The CO_2 emission coefficient can also include the equivalent emissions of other greenhouse gases (e.g. methane). To be more precise it should be specified by adding "equivalent" (e.g. CO_2 eq).

Note 2 to entry: In general, CO_2 emission coefficients from specific energy consumption (ISO 50001:2018, 3.5.2) are quantified based on CO_2 emission factors for use of the energy.

Note 3 to entry: CO_2 emission coefficients can differ by year.

Note 4 to entry: The CO_2 emission coefficient can also include the equivalent emissions of other greenhouse gases (e.g. methane).

[SOURCE: ISO 52000-1:2017, 3.5.4, modified — "such as burning one tonne of fuel in a furnace" has been moved from the end of the definition to an EXAMPLE. The original Notes 1 and 2 to entry have been deleted. Note 3 to entry is now Note 1 to entry with a new second sentence.]

3.5
assessment boundary
boundary where the delivered and exported *energy carriers* (3.2) are measured or calculated

[SOURCE: ISO 52000-1:2017, 3.4.2, modified — "energy" has been replaced by "energy carriers".]

3.6
energy flow
quantity of energy going from the energy source to the energy use

3.7
greenhouse gas
gas that absorbs and emits radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds

Note 1 to entry: Greenhouse gas can have natural and anthropogenic origins.

[SOURCE: ISO 14067:2018, 3.1.2.1, modified — "gaseous constituent of the atmosphere, both natural and anthropogenic" is simplified into "gas". Notes 1 to 3 to entry have been deleted and a new Note 1 to entry was added.]

3.8
biogenic carbon
carbon derived from biomass, but not fossilised

[SOURCE: ISO 14067:2018, 3.1.7.2, modified — "but not fossilised" has been added.]

3.9
fossil carbon
carbon that is contained in fossilized material

Note 1 to entry: Examples of fossilized material are coal, oil, natural gas and peat.

[SOURCE: ISO 14067:2018, 3.1.7.3]

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4 Symbols, subscripts and abbreviated terms

4.1 Symbols

For the purposes of this document, the symbols listed in Table 2 apply.

Table 2 includes symbols that are needed for overall consistency in the ISO 52000 series.

Table 2 — Symbols and units

Symbol	Quantity	Unit
c	coefficient	various [a]
E	energy in general [b]	kW·h
f	factor (e.g. primary energy factor, ...)	– [a]
H	calorific value, net or gross (NCV or GCV),	kW·h/kg
K	CO_2 emission coefficient	kg/(kW·h)
Q	quantity of heat	kW·h
η	efficiency (factor)	– [a]
ε	expenditure factor	– [a]

[a] Coefficients have dimensions; factors are dimensionless.

[b] Including primary energy; Note that for heat the symbol Q and for auxiliary energy and work the symbol W is used.

4.2 Subscripts

For the purposes of this document, the subscripts listed in Table 3 apply.

Table 3 includes subscripts that are needed for overall consistency in the ISO 52000 series.

Table 3 — Subscripts

Subscript	Term	Subscript	Term
CO_2	CO_2 emission	nren	non-renewable
cr	energy carrier		
del	delivered	P	primary energy
dis	distribution	nren	non-renewable primary energy
el	electricity	pr	produced
exp	exported	pv	solar electricity (photovoltaic)
gen	generation	ren	renewable energy
i, j, k	indexes	tot	total
in	input	we	weighting
ls	losses	Out	output

4.3 Abbreviated terms

For the purposes of this document, the abbreviated terms listed in Table 4 apply.

Table 4 — Abbreviated terms

Abbreviated term	Term
CHP	combined heat and power
EPB	energy performance of buildings
GHG	greenhouse gases

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Table 4 *(continued)*

Abbreviated term	Term
GWP	global warming potential
GCV	gross calorific value
LCA	live cycle analysis
NCV	net calorific value
PEF	primary energy factor
PV	photovoltaic
RES	renewables

5 General description of the methods and choices

5.1 Basic principles of the assessment methods

5.1.1 Primary energy factors (PEF)

5.1.1.1 Three fundamental types of PEF

For each delivered or exported energy carrier, there are three PEFs (see Figure 1) related to different energy contents of the energy carrier, to be assessed:

a) Non-renewable PEF ($f_{P;nren}$)

The primary energy taken into account in the non-renewable PEF covers only non-renewable energy flows (possibly including also, the non-renewable energy overheads of delivery to the point of use, according to the LCA method, see 6.4.4) required to deliver one unit of energy of the related energy carrier to the building. Therefore, the non-renewable PEF can be less than one if the unit of energy contains also renewable energy. It covers the whole non-renewable primary energy consumption, including those consumed by exploitation of the renewable sources when applicable.

b) Renewable PEF ($f_{P;ren}$)

The primary energy taken into account in the definition of renewable PEF covers only renewable energy flows (possibly including also, the renewable energy overheads of delivery to the point of use, according to the LCA method, see 6.4.4) required to deliver one unit of energy to the building per energy carrier. It covers all renewable primary energy including those consumed for the exploitation of the non-renewable sources (e.g. renewable energy used to produce electricity to drive an electric pump for pumping oil through a pipeline).

c) Total PEF ($f_{P;tot}$)

The total PEF is the sum of the non-renewable and renewable PEF.

5.1.1.2 PEF for delivered and exported energy

5.1.1.2.1 General

In accordance with ISO 52000-1, this document defines the PEF for delivered energy to the building through the assessment boundary and the energy produced “on-site” and exported through the assessment boundary.

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